R16

Code No: 136DQ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, May - 2019
REFRIGERATION AND AIR CONDITIONING
(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A **(25 Marks)**

1.a)	What is Ton of Refrigeration and write its value in kW?	[2]
b)	Differentiate between open and dense air refrigeration system.	[3]
c)	Describe the effect of condenser pressure on performance of VCRS.	[2]
d)	What is the function of expansion device in VCRS? Explain.	[3]
e)	Explain the differences between Azeotropes and Zeotropes.	[2]
f)	Describe the desirable chemical properties of a good refrigerant.	[3]
g)	What is the need of absorbent in vapour absorption refrigeration system?	[2]
h)	What is the operational principle of domestic refrigerator?	[3]
i)	Explain the principle of operation of a heat pump.	[2]
j)	How to estimate the specific enthalpy of moist air? Explain.	[3]

PART - B **(50 Marks)**

2.a) Draw P V and T S diagrams of actual air refrigeration system and discuss the salient points.

b) An aircraft cooling system consists of a compressor, cooler and expansion turbine. The compressor receives air at 1.2 bar and 60^0C from the engine supercharger. It is compressed isentropically with an efficiency of 75% to 1.6 bar and cooled to 55^0C. The air then expands isentropically through the turbine to 0.85 bar. The work developed is used to drive the compressor. The turbine exhaust air is then sent to the aircraft cabin for cooling. Determine: i) temperature of air at turbine exhaust and turbine efficiency ii) COP of the system. [5+5]

OR

3.a) Explain the principle of regenerative aircraft refrigeration system along with their practical limitations.

b) An air craft refrigeration plant has to handle a cabin load of 30 TR. The atmospheric temperature is 17^0C. The atmospheric air compressed to a pressure of 0.95 bar and temperature of 30^0C due to ram action, this air is then further compressed in a compressor to 4.75 bar, cooled in a heat exchanger to 67^0C, expanded in a turbine to 1 bar pressure and supplied to the cabin. The air leaves the cabin at a temperature of 27^0C. The isentropic efficiencies of both compressor and turbine are 0.9. Calculate the mass of air circulated per minute and the COP. For air, Cp= 1.004 kJ/kg K and γ= 1.4. [5+5]

4.a) Explain the impact of condenser temperature and evaporator temperature on the C.O.P of the system and substantiate the statements.

b) R-12 is used in a vapour compression refrigeration system with evaporator pressure of 1.6 bar and the condenser pressure of 9 bar. The refrigerant leaves the condenser at $30^0 C$ sub cooled and at the rate of 15 kg/min. Then calculate the refrigerating effect, refrigerating load (in TR), compressor input and COP of the system. [5+5]

OR

5.a) An ammonia refrigerator works between -6.7^{0}C and 26.7^{0}C. The vapour is dry saturated at the end of compression. Calculate: i) Theoretical COP and ii) Power required to drive the compressor if the cooling capacity of the refrigerator is 6 TR. Use the following properties of ammonia:

Temperature °C	Specific enthalpy kJ/kg		Specific entropy kJ/kg K	
	Liquid h_f	Vapour h_g	Liquid s_f	Vapour s_g
- 6.7	-29.26	1262.36	0.1087	4.7401
26.7	124.56	1291.62	0.4264	4.3263

b) Differentiate between wet compression and dry compression and discuss the significance of dry and wet compression systems. [5+5]

6.a) Derive an expression for the shaft work of a reciprocating compressor assuming zero clearance volume.

b) Single stage reciprocating compressor is required to compress 1.5 m^3/min of vapour refrigerant from 1 bar to 8 bar. Find the power required to drive the compressor, if the compression of refrigerant is (i) Isothermal; (ii) polytropic with an index as 1.12; and (iii) isentropic with isentropic index as 1.31. [5+5]

OR

7.a) Explain the working principle of evaporative condenser used in vapour compression refrigeration system with the suitable diagrams.

b) What are the ill effects on the environment by using different refrigerants? Suggest the methods to minimize these effects. [5+5]

8.a) In an absorption type refrigerator, the heat supplied to NH_3 generator by condensing steam at 2 bar and 90% dry, the temperature in the refrigerator is to be maintained at -5^0 C. Find the maximum C.O.P possible. If the refrigeration load is 20 tonnes and actual C.O.P is 70% of the maximum C.O.P., find the mass of steam required per hour. Take the temperature of the atmosphere as 30^0 C.

b) Explain the function of each fluid in a 3-fluid vapour absorption system and discuss the properties of all the three fluids. [5+5]

OR

9.a) Describe the method to estimate the maximum COP of vapour absorption refrigeration system.

b) In a Steam jet refrigeration system dry saturated steam at 7 bar abs. pressure is supplied. The flash chamber temperature is 5oC, the condenser temperature is 40^{0}C, make up water is supplied at 20^{0}C. Assuming that quality of motive steam and flash vapour at the beginning of compression as 93% dry and efficiency of the nozzle, efficiency of entertainment and the efficiency of the thermo-compressor as 90%, 65% and 91% respectively. Determine: (i) Weight of steam required per hour per ton of refrigeration. (ii) The volume of vapour removed from the flash chamber per hour per ton of refrigeration. [5+5]

10.a) Explain the method of preparation of psychometric chart based on thermodynamic principles.

b) An air conditioned auditorium is to be maintained at 27^0C DBT and 60% relative humidity. The ambient condition is 40^0 C DBT and 30^0 C WBT. The total sensible heat load is 100000 kJ/h and total latent heat load is 400000 kJ/h. 60% of the return air is re-circulated and mixed with 40% of make-up air after the cooling coil. The condition of air leaving the cooling coil is at 18^0 C. Determine: i) Room sensible heat factor; ii) The condition of air entering the auditorium; iii) The amount of make-up air; iv) Apparatus dew point; v) Bypass factor of the cooling coil. And also show the process on psychometric chart. [5+5]

OR

11.a) Differentiate among split and central air conditioning system and explain different applications of these systems.

b) A class room capacity of 50 persons (sensible heat gain per person 100 W, latent heat gain per person 25W, other heat gains are 3000W) is to be maintained at 15^0C DBT, 50% relative humidity, The ambient conditions are 40^0C DBT and 27^0C WBT. Air is supplied to the room at 7^0C, 100 % RH. Calculate (i) the mass of moist air supplied to the room, (ii) the cooling load of the air washer in kW, if 30% of the air supplied to the room is fresh and the remained being recirculated. [5+5]

---ooOoo---